PRODUCTION's Manufacturing PLANBOOK 1981-82

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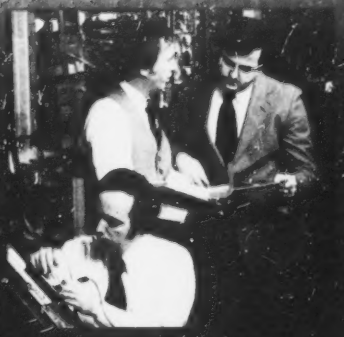

- How to Plan:
  —Production Plants
  —Contract Job Shops
- Planning for Productivity:
  —Whose Job Is It . . . How Do You Measure Results?
- Improving Productivity in Small Shops
- Quality-of-Work-Life and Manpower Planning
- Planning for MRP . . . and Odd Lot Production
- PLUS: Capital Spending Outlook . . . Technology Update . . . Buyers' Index

PRODUCTION's
Manufacturing PLANBOOK 1981-82

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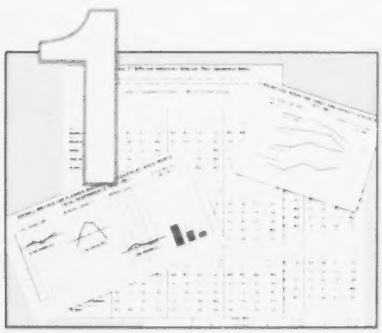
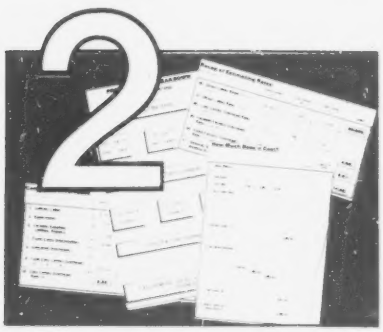


Outlook/Trends...p.9

Nine pages of charts and tables reveal 1981-82 spending plans and trends allowing you to compare your investment programs with others in your industry. Details on cost reduction targets . . . reasons for spending . . . five year trend tables showing investment patterns by industry . . . allocations for NC/CNC, flexible machining systems and computer control . . . industry spending patterns by machine/equipment categories . . . and more.



How to Plan...p. 43

Practical procedures and tools to help you do a better job of planning. Covers planning to allow for flexibility to meet changing industry needs . . . profitability planning for job shops . . . whether you should consider MRP . . . how to exploit opportunities offered through technology transfer . . . how to plan optimum run quantities for non-repetitive operations . . . improving productivity . . . the developing involvement of Quality of Work Life and manpower planning.

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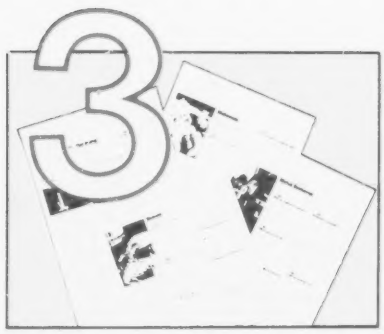

Update...p. 97

Update provides more than 000 write-ups on current developments, new machines, tools, equipment and materials. Items are brief and have been arranged by category and then grouped into subsections for your ready reference. Categories include: Assembly . . . cleaning/finishing . . . gaging/inspection/testing . . . heat processing . . . joining . . . materials . . . metalforming . . . metal removal . . . plastic molding/forming . . . process and machine control . . . robots.

Buyers' Index...p. 197

Every editorial and advertised item has been organized by category to help you locate the source quickly. The company name, address and editorial/advertising reference is located under the appropriate process, material or equipment category: Assembly . . . finishing . . . gaging/inspection/testing . . heat processing . . . joining . . . materials . . . metalforming . . . metal removal . . . plastic molding/forming . . . process and machine control . . . robots. Everything presented in this workbook.

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Outlook/ Trends

How do your capital spending outlays compare with others in your industry? What are your cost targets? Reasons for spending? Nine pages of charts and tables reveal spending plans and directions to help you answer these questions. They should help you take measure of your manufacturing position.

10 **Highlights and Survey Scope**

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Capital Spending 1981

An Outlook which allows you to:

- Note changing trends and objectives in machinery/equipment purchase and use
- Compare your machinery/equipment investment with others in your industry

In the fall of 1980, the Research Division of Bramson Publishing Co. surveyed the 1981 capital spending plans for machinery/equipment in the metalworking market.* Findings indicate how funds will be invested and reasons for spending. Data are provided in charts and tables which should help allow you to determine your plant's competitive manufacturing capability in terms of other plants in your specific industry as well as metalworking manufacturing plants generally.

In the broadest sense . . .
You're typical if your plant is planning to apportion its investment for machinery and equipment as depicted by the following table:

	Percent of Investment 1981	Percent Deviation 1981 from 5-Year Average
Metalcutting machine tools	35.1%	+ 8.7%
Assembly machines/equipment	16.3%	+ 7.2%
Metalforming machine tools	9.0%	- 29.7%
Cleaning-finishing equipment	7.7%	+ 26.2%
Material handling	7.1%	- 8.5%
Gaging-inspection-testing	5.0%	- 12.3%
Weld-rivet-braze	4.8%	- 5.9%
Plastic mold-form equipment	2.7%	- 10.0%
Heat processing equipment	2.6%	+ 8.3%
Other	10.3%	+ 1.0%

You're also typical if in 1981 . . .

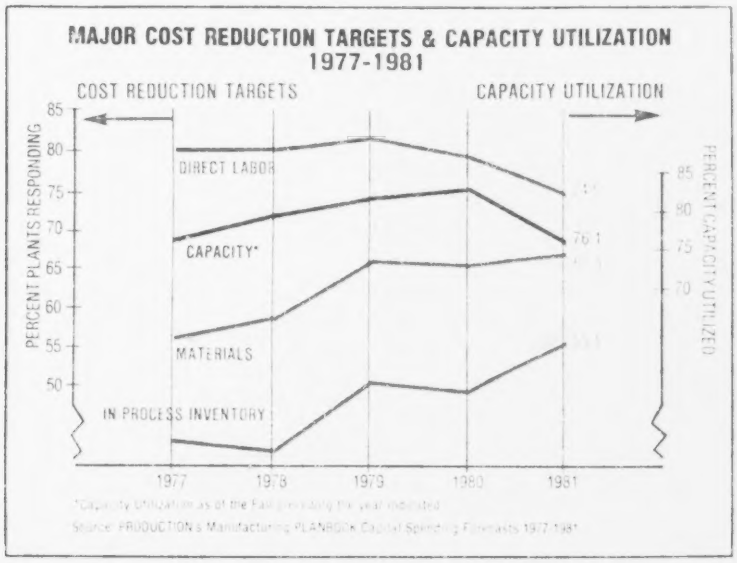
Your plant employs	and	Your machinery/equipment and expenditures are
50-90 persons		$ 174,000
100-499 persons		$ 368,000
500-999 persons		$ 699,000
1000 or more persons		$1,080,000

And . . .

- You were operating at 76.1% capacity utilization in the fall of 1980, down from 83.0% at the time of the survey the year previous. Interestingly, 60.2% of you plan to operate at a higher level and only 8.6% at a lower level this year;
- You'll source 11% of your total machinery/equipment purchases with foreign suppliers. Most of these dollars will be spent on metalcutting and metalforming machines;
- You expected to obtain approval for 84% of your submitted machinery/equipment budget and felt you would have it approved and in hand by early December;
- Your company requires a 32% first-year return-on-investment (pre-tax) in justifying new equipment, up from 28% one year ago;
- You will be allocating larger shares of the equipment dollar to metalcutting machines (up 4 percentage points from last year), assembly ma-

(continued)

***Survey scope:** *Plants reached by PRODUCTION Magazine and the Manufacturing PLANBOOK in: Fabricated Metal Products (SIC 34); Machinery, except Electrical (SIC 35); Electrical Machinery (SIC 36); Transportation Equipment (SIC 37); and Instruments (SIC 38) which employ 50 or more persons. 1981 figures are projected from respondents from 12,000 plants contacted in the survey in the fall of 1980, in keeping with past procedures. See January 1981 issue of PRODUCTION Magazine for other capital spending details not included in this presentation.*

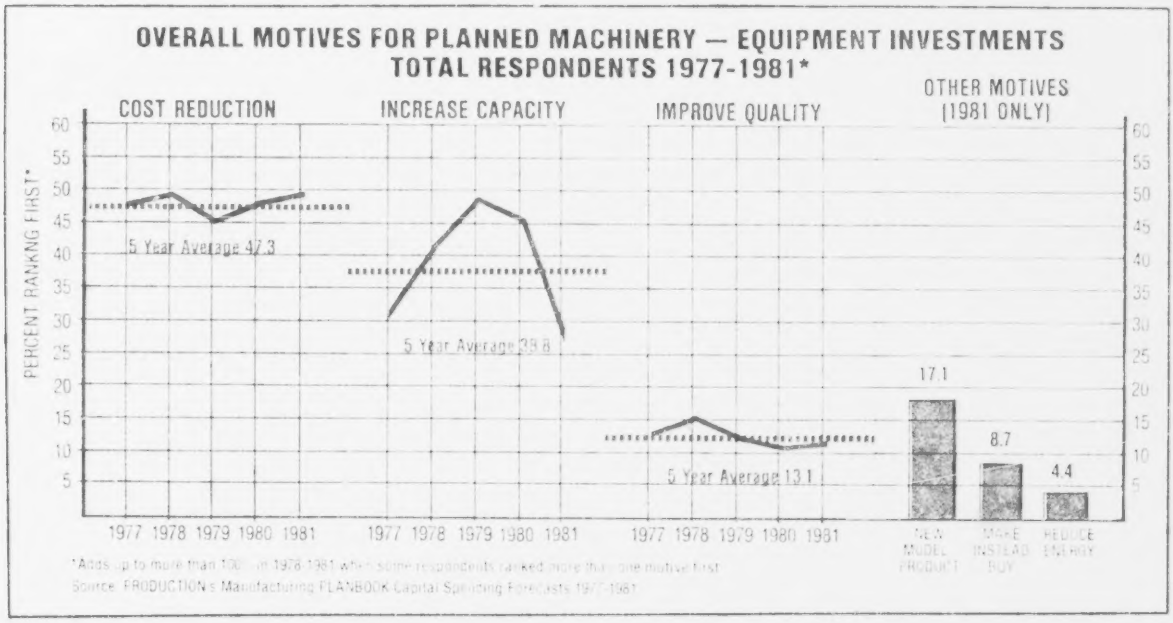


The Relationship of Cost Reduction Targets to Capacity

Direct Labor: Year in and out the number one target. Note decline of 5 percentage points since last year — the lowest it's been in 10 years. Contributing factors include: Increased attention by many of you to indirect labor, and the adjustments in direct labor already made as capacity fell. As capacity moves up, direct labor cost interest will lag for the first 6 to 12 months before picking up.

Materials: Heightened interest in materials utilization as a buffer to falling margins as capacity declines. Most interest evidenced for this cost reduction target since 1974.

In-Process Inventory: Big swing in interest as capacity falls and the 30% carrying charge for inventory rears its ugly head. Attention to in-process inventory always increases when sales declines force production cutbacks.



Motives for Capital Equipment Investments

Cost Reductions: With the exception of 1979, the most important motive. Usually turns up when capacity requirements ease. Two out of three of you ranked cost reduction as the first or second reasons for investment.

Increase Capacity: Most of you report no squeeze in capacity requirements. Second big drop in two years after a steady climb. Lowest position in last five years falling 10 percentage points below the 5-year average.

Improve Quality: Continues as secondary motive to purchase capital equipment. This in spite of some industries whose products are faced with a "poor quality" image as perceived by many of their customers and prospects.

New Products/Models: The third most important motive for 1981 spending.

Make Instead of Buying: Always rises in importance when capacity utilization falls and you bring in work formerly contracted for on the outside.

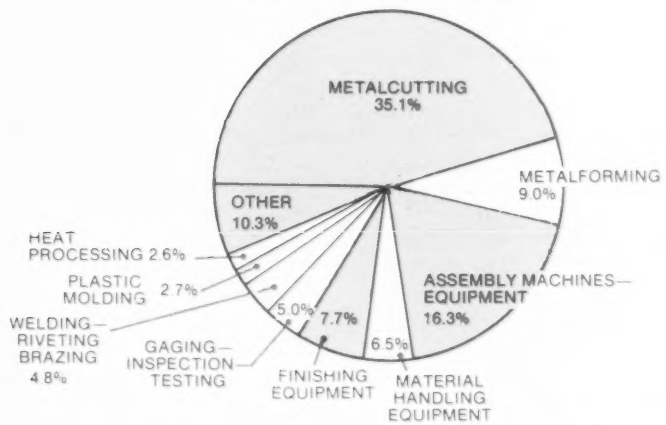
Reduce Energy Consumption: Only 4.4% of you ranked this as the primary motive. Gaining in importance as a factor affecting cost of operation and ability to produce due to energy availability.

chines and equipment, and cleaning-finishing equipment. Smaller shares will go to metalforming machines (down to a 9.0% slice of the equipment pie), material handling, gaging-inspection-testing, welding-riveting-brazing, plastic molding and heat processing equipment.

All in all . . .

You will spend $11.7 billion in 1981 for machinery/equipment (1981 dollars). This means a 10% drop in real spending. Three-quarters of you are planning to spend the same or more compared to one year ago (31.4% the same, 43.8% more). Only 18.1% plan to spend less. The remaining 6.6% of the respondents did not answer the question.

HOW THE 1981 CAPITAL EQUIPMENT DOLLAR WILL BE SPENT



Color indicates increased proportions of category investment in 1981.

Numerical Control

Numerically controlled equipment continues to take over more of your metalcutting, metalforming, gaging and assembly operations. Over the last five years, the number of plants reporting their purchase plans included NC or CNC equipment jumped from 34.4% in 1977 to 44.6% this year — a gain of almost 30%! At the time the survey was conducted, 47.7% of you reported your plant operated NC or CNC equipment. These plants account for 85.9% of all installations purchasing these machines.

Horizontal turning, horizontal and vertical machining centers and milling machines account for the majority of activity for the next three years. Here are the types of machines those plants intend to purchase with the year of purchase indicated:

Percent Intending To Purchase NC or CNC

	1981	1982	1983
Machining Center-Horizontal	21.6	16.3	9.0
Machining Center-Vertical	20.6	14.1	8.0
Boring	7.9	5.2	4.0
Drilling	13.3	10.5	5.2
Grinding	8.8	7.6	4.0
Milling	14.7	11.6	5.2
Turning-Horizontal	29.3	21.7	12.7
Turning-Vertical	5.9	5.9	4.6
Punching	9.5	7.1	5.5

Flexible Manufacturing Systems

They're past the curiosity stage. Almost 20% of total respondents report their plans include purchase of one type or another flexible system within the next three years. These systems run the gamut from machining centers on one hand through indexers, headchangers, multiple machining center systems, combination systems to multiple-station automatic systems with limited flexibility. Here are your reported plans for purchase:

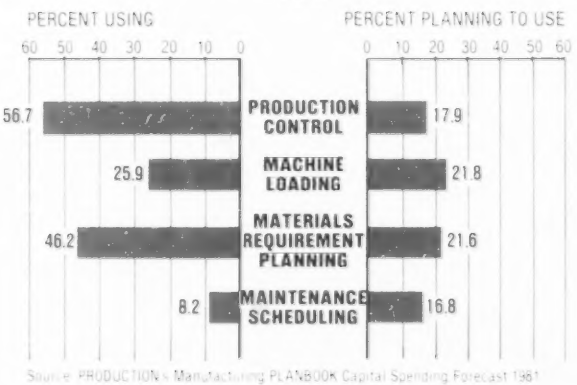
Will Buy Flexible Systems — Type and Timing

	1981	1982	1983
Flexible-Single Spindle	8.3%	6.2%	3.5%
Flexible-Multiple Spindle	4.9%	4.0%	2.9%

Computer Use

Last fall, 30.3% of you reported your plant operated a portion of your production equipment or facility with computers or minicomputers. Another 4.5% plan to in 1981; 7.2% in 1982. We are projecting half the plants we reach will operate a portion of their production equipment by computer or minicomputer by 1983.

USE OF COMPUTERIZED DATA SYSTEMS FOR



Source: PRODUCTION's Manufacturing PLANBOOK Capital Spending Forecast 1981

The use of computerized data systems has taken off as these management tools have enabled you to make better and faster decisions affecting manufacturing costs and profits.

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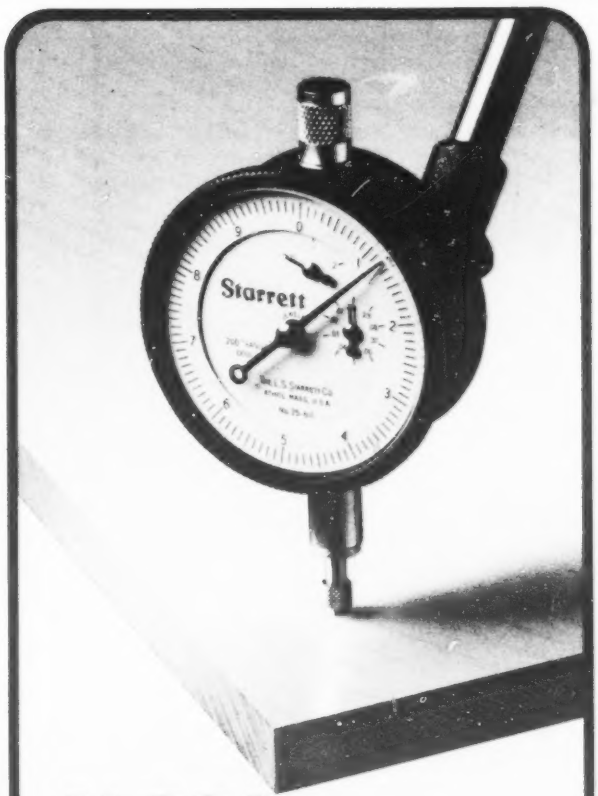

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The charts on the next three right hand pages are provided to help you compare your capital investment directions with others in your industry.

They show spending allocations by industry for different kinds of production equipment. Allocations are shown in percentages so that you can develop data which is comparable.

The spending pattern is based on five years of investment — four previous and one forecast. This should even out year-by-year discrepancies between individual plants and an industry total.

How to Use the Charts

1. Find your industry. If you are not familiar with standard industrial classification numbers (SICs), look at the address label on the PLANBOOK cover. The four-digit number on line one above your name and title is the SIC number assigned to your plant. Use the first three numbers to locate your industry.
2. Obtain a percentage breakdown by category of your plant's capital equipment expenditures.
3. Compare your expenditures with spending patterns of your industry.
4. If your spending profile doesn't approximate your industry's, you should probably be asking questions why.

Here's How 27 Different Industries Allocate Their Equipment Dollar

Find your industry. Compare your capital spending patterns with others in your industry.
If your spending profile doesn't approximate your industry's, maybe you should be asking questions why. See page 14.

Trends in Equipment Purchases — 1981 to five year average

(Percent Total Expenditures)

	Cutlery, Hand Tools & Hardware (SIC 342)				Heating Equipment, Except Electric & Warm Air and Plumbing Fixtures (SIC 343)				Fabricated Structural Metal Products (SIC 344)			
	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average
Metalcutting machines	29.2%	27.1%	20.8%	+ 30.3%	25.2%	18.9%	19.8%	- 4.5%	15.7%	13.7%	13.0%	+ 5.4%
Assembly equipment	14.4	15.8	15.3	+ 3.3	10.0	17.2	14.6	+ 17.8	15.5	14.4	13.7	+ 5.1
Metalforming machines	19.3	16.1	15.7	+ 2.5	14.2	17.1	21.1	- 19.0	21.1	22.8	20.4	+ 11.8
Material handling equipment	7.8	7.2	6.9	+ 4.3	7.0	7.7	10.0	- 23.0	10.3	10.8	13.9	- 22.3
Cleaning/finishing equipment	9.3	10.8	11.1	- 2.7	7.0	9.3	8.0	+ 16.3	7.2	9.1	7.5	+ 21.3
Welding	3.5	3.0	4.3	- 30.2	6.1	8.7	5.7	+ 52.6	13.9	13.9	15.2	- 8.6
Gaging/Inspection/Testing	2.2	2.9	3.1	- 6.5	3.4	2.0	2.4	- 16.7	2.2	2.4	2.4	—
Plastic mold-form equipment	2.2	3.7	5.6	- 33.9	5.1	4.5	4.2	+ 7.1	0.4	0.3	1.2	- 75.0
Heat treating equipment	4.8	5.2	5.4	- 3.7	2.9	3.6	1.7	+111.8	4.0	1.9	2.0	- 5.0
All other	7.3	8.2	11.8	- 30.5	18.1	11.0	12.3	- 10.6	9.7	10.7	10.7	—

	Screw Machine Products, Fasteners (SIC 345)				Metal Forgings & Stampings (SIC 346)				Miscellaneous Fabricated Metal Products (SIC 349)			
	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average
Metalcutting machines	50.0%	51.8%	43.4%	+ 19.4%	15.8%	15.6%	14.8%	+ 5.4%	26.8%	31.3%	33.1%	- 5.8%
Assembly equipment	6.8	8.9	9.6	- 7.3	7.5	11.1	11.8	- 5.9	9.8	14.6	10.8	+ 35.2
Metalforming machines	20.1	16.4	15.1	+ 8.6	41.5	40.1	35.9	+ 11.7	14.8	13.0	15.0	- 13.3
Material handling equipment	3.7	3.7	6.9	- 46.4	8.6	6.9	9.5	- 27.4	7.0	6.4	7.4	- 13.5
Cleaning/finishing equipment	3.5	5.2	5.3	- 1.9	6.8	6.7	6.6	+ 1.5	7.5	7.8	5.6	+ 39.3
Welding	—	0.2	0.4	- 50.0	3.8	3.4	4.8	- 29.2	4.5	5.6	5.9	- 5.1
Gaging/Inspection/Testing	3.9	5.1	4.5	+ 13.3	3.0	3.9	3.2	+ 21.9	6.7	3.5	3.9	- 10.3
Plastic mold-form equipment	0.7	0.2	0.5	- 60.0	4.2	3.4	2.8	+ 21.4	3.0	2.4	2.0	+ 20.0
Heat treating equipment	6.8	2.5	4.6	- 45.7	2.1	3.9	2.6	+ 50.0	9.8	2.4	4.8	- 50.0
All others	4.5	6.0	9.7	- 38.1	6.7	5.0	8.1	- 35.8	10.1	13.0	11.4	+ 14.0

	Engines & Turbines (SIC 351)				Farm & Garden Machinery and Equipment (SIC 352)				Construction, Mining and Material Handling Equipment (SIC 353)			
	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average
Metalcutting machines	43.2%	59.6%	55.1%	+ 8.2%	19.9%	18.4%	25.7%	- 28.4%	38.2%	41.7%	45.6%	- 8.6%
Assembly equipment	7.4	4.5	6.0	- 25.0	6.0	5.9	6.5	- 9.2	3.6	5.4	5.1	+ 5.5
Metalforming machines	4.5	1.5	4.7	- 68.1	29.6	29.4	23.0	+ 27.8	14.0	13.9	11.8	+ 17.8
Material handling equipment	11.2	6.3	7.3	- 13.7	12.7	11.4	10.0	+ 14.0	11.0	7.2	10.1	- 28.7
Cleaning/finishing equipment	8.5	4.8	4.1	+ 17.1	8.0	10.5	9.5	+ 10.5	4.6	6.6	5.2	+ 26.9
Welding	3.0	3.7	3.5	+ 5.7	14.2	8.3	7.6	+ 9.2	9.4	8.6	8.3	+ 6.0
Gaging/Inspection/Testing	7.4	3.1	5.3	- 41.5	2.5	1.8	3.1	- 41.9	8.0	2.6	3.8	- 31.6
Plastic mold-form equipment	2.1	0.8	1.1	- 27.3	0.5	—	0.3	-100.0	0.3	0.8	0.5	+ 60.0
Heat treating equipment	6.1	4.7	2.9	+ 62.1	0.7	1.4	2.9	- 51.7	3.3	2.2	2.9	- 31.8
All others	10.8	11.0	10.8	+ 1.9	5.9	12.9	11.3	+ 14.2	7.5	10.0	6.4	+ 56.3

Here's How 27 Different Industries Allocate Their Equipment Dollar

Find your industry. Compare your capital spending patterns with others in your industry.
If your spending profile doesn't approximate your industry's, maybe you should be asking questions why. See page 14.

Trends in Equipment Purchases — 1981 to five year average

Percent of Total Expenditures

	Metalworking Machinery and Equipment (SIC 354)				Special Industry Machinery (SIC 355)				General Industrial Machinery and Equipment (SIC 356)			
	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average
Metalcutting machines	61.1	62.1	63.1	- 1.6	43.4	48.8	52.2	- 6.5	48.8	49.1	48.1	+ 2.1
Assembly equipment	3.6	3.6	4.2	- 14.3	5.1	6.5	4.5	+ 44.4	8.5	10.3	9.5	+ 8.4
Metalforming machines	8.3	6.2	7.6	- 18.4	12.9	13.5	10.4	+ 30.8	9.4	10.8	9.8	+ 10.2
Material handling equipment	3.7	3.6	4.2	- 14.3	8.4	5.1	7.2	- 25.0	7.6	5.3	7.9	- 32.9
Cleaning/finishing equipment	4.5	4.0	2.2	+ 81.8	6.0	4.2	3.6	+ 16.7	3.0	4.9	3.4	+ 44.1
Welding	1.2	2.2	1.3	+ 69.2	7.7	6.8	5.8	+ 17.2	5.3	6.6	4.2	+ 57.1
Gaging/Inspection/Testing	4.7	5.3	5.3	+ 0.0	5.0	4.0	4.2	- 4.8	4.0	4.3	4.9	- 12.2
Plastic mold-form equipment	1.0	1.9	2.5	- 24.0	2.0	2.1	1.2	+ 75.0	1.7	0.6	1.3	- 53.8
Heat treating equipment	5.5	2.3	3.0	- 23.3	1.3	1.5	1.9	- 21.1	3.5	3.3	3.3	—
All others	6.4	9.6	6.8	+ 41.1	7.2	7.1	8.9	- 20.2	8.2	6.6	8.4	- 21.4

	Office, Computing and Accounting Machines (SIC 357)				Refrigeration and Service Industry Machinery (SIC 358)				Miscellaneous Machinery, Except Electrical (SIC 359)			
	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average
Metalcutting machines	17.9	21.4	17.4	+ 23.0	20.2	22.2	19.1	+ 16.2	50.9	54.2	53.4	+ 1.5
Assembly equipment	25.3	30.1	29.1	+ 3.4	13.9	11.7	13.1	- 10.7	11.5	8.6	7.4	+ 16.2
Metalforming machines	8.8	9.2	9.0	+ 2.2	26.3	23.0	27.4	- 16.1	8.4	6.9	8.2	- 16.9
Material handling equipment	7.9	7.1	7.0	+ 1.4	8.8	9.7	8.1	+ 22.2	4.7	1.7	5.3	- 11.3
Cleaning/finishing equipment	5.7	4.3	5.3	- 18.9	8.1	8.8	9.3	- 5.4	6.4	7.1	5.4	+ 31.5
Welding	2.3	1.7	2.7	- 37.0	5.8	6.5	7.2	- 8.3	3.2	3.6	3.6	—
Gaging/Inspection/Testing	21.2	12.5	14.9	- 16.1	4.2	3.4	4.0	- 15.0	4.7	4.5	5.6	- 17.9
Plastic mold-form equipment	2.6	5.3	3.1	+ 71.0	2.0	4.4	3.4	+ 29.4	1.4	1.7	1.2	+ 41.7
Heat treating equipment	0.6	0.8	0.6	+ 33.0	0.3	2.4	0.5	+380.0	5.2	2.3	3.2	- 31.3
All others	7.7	8.6	10.9	- 21.1	10.4	7.8	7.8	—	3.5	6.3	6.5	- 3.1

	Electrical Transmission and Distribution Equipment (SIC 361)				Electrical Industrial Apparatus (SIC 362)				Household Appliances (SIC 363)			
	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average
Metalcutting machines	18.4	18.4	17.0	+ 8.2	32.9	31.9	28.8	+ 10.8	8.2	12.4	8.8	+ 40.9
Assembly equipment	23.5	27.6	24.8	- 11.3	22.0	22.3	20.2	+ 10.4	17.7	20.6	20.0	+ 3.0
Metalforming machines	14.0	15.1	14.2	+ 6.3	10.3	8.7	11.0	- 20.9	25.6	25.2	23.7	+ 6.3
Material handling equipment	7.5	7.2	6.5	+ 10.8	7.8	7.7	8.1	- 4.9	9.5	6.5	9.7	- 33.0
Cleaning/finishing equipment	7.7	9.8	8.3	+ 18.1	4.7	4.4	5.5	- 20.0	11.1	9.9	8.6	+ 15.1
Welding	4.9	3.6	5.2	- 30.8	3.3	2.8	3.6	- 22.2	4.7	7.3	6.3	+ 15.9
Gaging/Inspection/Testing	5.8	5.7	7.4	- 23.0	7.2	9.3	6.0	+ 55.0	3.6	3.8	3.7	+ 2.7
Plastic mold-form equipment	4.1	6.2	5.1	+ 21.6	2.9	2.8	3.9	- 17.9	11.0	6.5	7.5	- 13.3
Heat treating equipment	0.2	1.7	0.8	+112.5	0.6	1.6	1.1	+ 45.5	1.0	1.4	1.9	- 26.3
All others	13.9	4.7	10.5	- 55.2	8.3	8.5	11.9	- 28.6	7.6	6.4	9.7	- 35.1

Here's How 27 Different Industries Allocate Their Equipment Dollar

Find your industry. Compare your capital spending patterns with others in your industry.
If your spending profile doesn't approximate your industry's, maybe you should be asking questions why. See page 14.

Trends in Equipment Purchases — 1981 to five year average

(Percent Total Expenditures)

	Electric Lighting and Wiring Equipment (SIC 364)				Communication Equipment (SIC 366)				Electronic Components & Accessories (SIC 367)			
	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average
Metalcutting machines	6.5%	15.1%	14.4%	+ 4.9%	18.3%	20.6%	20.0%	+ 3.0%	17.7%	14.3%	12.6%	+ 13.5%
Assembly equipment	18.7	26.1	25.4	+ 2.8	28.6	30.1	27.8	+ 8.3	28.8	33.8	32.7	+ 3.4
Metalforming machines	28.4	18.7	18.1	+ 3.3	9.1	7.9	8.6	- 8.1	11.0	7.1	7.4	- 4.1
Material handling equipment	8.0	6.0	8.2	- 26.8	8.6	6.5	5.6	+ 16.1	4.0	4.2	3.8	+ 10.5
Cleaning/finishing equipment	13.8	8.9	7.9	+ 12.7	5.0	5.2	5.9	+ 5.1	6.3	8.7	7.2	+ 20.8
Welding	3.5	1.9	2.9	- 34.5	1.7	2.0	2.5	- 20.0	2.3	3.2	2.5	+ 48.0
Gaging/Inspection/Testing	2.9	3.7	4.1	- 9.8	13.3	15.2	14.9	+ 2.0	11.6	8.6	10.6	- 18.9
Plastic mold-form equipment	7.1	8.8	7.5	+ 17.3	4.2	2.5	3.6	- 30.6	9.3	5.1	7.1	- 39.2
Heat treating equipment	2.7	1.4	1.2	+ 16.7	0.5	1.4	0.9	+ 55.6	1.4	2.5	1.8	+ 38.9
All others	8.4	9.4	10.4	- 9.6	10.7	7.6	10.6	- 28.3	7.6	12.5	13.6	- 8.1

	Miscellaneous Electrical Machinery & Equipment (SIC 369)				Motor Vehicles & Motor Vehicle Equipment (SIC 371)				Aircraft and Parts (SIC 372)			
	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average
Metalcutting machines	15.5%	14.9%	14.5%	+ 2.8%	26.5%	30.5%	28.3%	+ 7.8%	51.6%	53.1%	52.4%	+ 1.3%
Assembly equipment	25.1	35.7	35.5	+ 1.0	12.6	17.0	16.7	+ 1.8	6.6	5.0	5.7	- 12.3
Metalforming machines	8.6	9.1	8.4	+ 8.3	11.7	13.2	14.7	- 10.2	9.0	9.4	8.3	+ 13.3
Material handling equipment	4.8	6.1	5.7	+ 7.0	6.3	8.6	8.7	- 1.1	3.4	3.4	3.6	- 5.6
Cleaning/finishing equipment	4.8	4.6	3.7	+ 24.3	6.2	6.5	5.6	+ 16.1	3.4	5.1	4.1	+ 24.4
Welding	4.0	4.1	3.8	+ 7.9	10.4	6.7	6.5	+ 3.1	9.4	6.2	5.8	+ 6.9
Gaging/Inspection/Testing	15.7	5.0	8.3	- 39.8	6.9	4.8	5.3	- 9.4	7.6	7.8	7.6	+ 2.6
Plastic mold-form equipment	7.4	7.3	7.7	- 5.2	7.8	3.2	3.0	+ 6.7	1.6	0.7	1.4	- 50.0
Heat treating equipment	0.6	1.3	0.7	+ 85.7	2.5	2.8	2.7	+ 3.7	2.2	3.5	4.4	- 20.5
All others	13.5	11.9	11.7	+ 1.7	9.1	6.7	8.9	- 24.7	5.1	5.8	6.7	- 13.4

	Engineering, Laboratory, Scientific & Research Instruments (SIC 381)				Measuring & Controlling Instruments (SIC 382)				Surgical, Medical & Dental Instruments & Supplies (SIC 384)			
	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average	1980	1981	5 year average	Deviation 1981 from five year average
Metalcutting machines	22.6%	27.5%	23.9%	+ 15.1%	32.5%	31.2%	29.1%	+ 7.2	16.6%	18.6%	21.6%	- 13.9%
Assembly equipment	7.3	26.3	20.0	+ 31.5	19.0	26.1	23.9	+ 9.2	30.9	30.2	25.0	+ 20.8
Metalforming machines	6.0	6.6	14.1	- 53.2	8.4	6.9	7.8	- 11.5	8.3	9.2	8.6	+ 7.0
Material handling equipment	2.3	4.5	4.6	- 2.2	5.3	4.9	4.7	+ 4.3	6.1	5.0	6.7	- 25.4
Cleaning/finishing equipment	3.0	8.2	6.0	+ 36.7	3.1	4.0	4.1	- 2.4	3.0	5.8	3.8	+ 52.6
Welding	0.9	3.1	2.8	+ 10.7	3.2	4.0	5.3	- 24.5	4.1	2.5	4.6	- 45.7
Gaging/Inspection/Testing	22.4	10.5	12.1	- 13.2	7.5	9.1	7.0	+ 30.0	6.6	5.2	8.7	- 40.2
Plastic mold-form equipment	12.9	1.1	3.8	- 71.1	11.5	4.7	5.6	- 28.6	14.4	14.9	11.3	+ 31.9
Heat treating equipment	0.3	1.3	0.5	+160.0	1.0	1.8	2.0	- 10.0	1.4	1.1	0.7	+ 57.1
All others	22.3	10.9	12.1	- 9.9	8.5	7.3	9.6	- 24.0	8.6	7.5	8.6	- 12.8

Spending Patterns

For each of the eight production equipment categories shown below, the industries that are listed account for the bulk* of the total 1981 investment in that type of equipment. Industries not listed do not invest significantly in equipment of that type.

You can compare your company's investment pattern with your industry's spending plans by determining the percentage of your capital investment budget that will go for each of these eight equipment categories.

*These industries account for 75 percent or more of the planned investment for these types of equipment according to our survey.

Cleaning-Finishing Equipment

SIC	Industry	Percent of Total Capital Expenditures
342	Cutlery, hand tools & hardware	10.8%
343	Heating equip., except electric & plumbing fixtures	9.3%
344	Fabricated structural steel prod.	9.1%
346	Forgings & stampings	6.7%
349	Misc. fabricated products	7.8%
352	Farm & garden machinery	10.5%
358	Refrig. & service industry machy.	8.8%
359	Misc. machy., except elec.	7.1%
361	Elec. transmission & dist. equip.	9.8%
363	Household appliances	9.9%
364	Elec. lighting & wiring equip.	8.9%
367	Electronic components & access.	8.7%
371	Motor vehicles, motor veh. equip.	6.5%
381	Engineering lab, scientific & research instruments	8.2%

Metalforming Machinery and Equipment

SIC	Industry	Percent of Total Capital Expenditures
342	Cutlery, hand tools & hardware	16.1%
343	Heating equip., except elec. & plumbing fixtures	17.5%
344	Fab. structural steel products	22.8%
345	Screw machine products	16.4%
346	Forgings & stampings	40.1%
349	Misc. fabricated products	14.6%
352	Farm & garden machinery	29.4%
353	Construction, mining, oil field & matl. handling equip.	13.9%
358	Refrig. & service industry machy.	23.0%
361	Elec. transmission & dist. equip.	15.1%
363	Household appliances	25.2%
364	Elec. lighting & wiring equip.	18.7%
371	Motor vehicles, motor veh. equip.	13.2%

Heat Processing Equipment

SIC	Industry	Percent of Total Capital Expenditures
342	Cutlery, hand tools & hardware	5.2%
343	Heating equip., except electric & plumbing fixtures	3.6%
346	Forgings & stampings	3.9%
351	Engines & turbines	4.7%
353	Construction, mining, oil field & matl. handling equip.	2.2%
354	Metalworking machy. & equip.	2.3%
356	General industry machy. & equip.	3.3%
358	Refrig. & service industry machy.	2.4%
359	Misc. machy., except elec.	2.3%
367	Electronic components & access.	2.5%
371	Motor vehicles, motor veh. equip.	2.8%
372	Aircraft & parts	3.5%

Metalcutting Machine Tools

SIC	Industry	Percent of Total Capital Expenditures
345	Screw machine parts	51.8%
349	Misc. fabricated products	31.3%
351	Engines & turbines	59.6%
353	Construction, mining, oil field & matl. handling equip.	41.7%
354	Metalworking machy. & equip.	62.1%
355	Special industry machy.	48.8%
356	General indl. machy. & equip.	49.1%
359	Misc. machy. except elec.	54.2%
362	Electrical indl. apparatus	31.9%
371	Motor vehicles, motor veh. equip.	30.5%
372	Aircraft & parts	53.1%
382	Measuring & controlling instruments	31.2%

Assembly Equipment

SIC	Industry	Percent of Total Capital Expenditures
342	Cutlery, hand tools, hardware	15.8%
343	Heating equip., except electric & plumbing fixtures	17.2%
344	Fabricated structural steel prod.	14.4%
349	Misc. fabricated products	14.6%
356	General industry machy. & equip.	10.3%
357	Office, computing & acctg. machy.	30.1%
358	Refrig. & service industry machy.	11.7%
361	Elec. transmission & dist. equip.	27.6%
362	Elec. industrial apparatus	22.3%
363	Household appliances	20.6%
364	Elec. lighting & wiring equip.	26.1%
366	Communications equipment	30.1%
367	Electronic components & access.	33.8%
369	Misc. electrical machy., equip., supplies, nec.	35.7%
371	Motor vehicles, motor veh. equip.	17.0%
381	Engineering lab, scientific & research instruments	26.3%
382	Measuring & controlling instruments	26.1%
384	Surgical, medical & dental instr. & supplies	30.2%

Gaging-Inspection and Testing Equipment

SIC	Industry	Percent of Total Capital Expenditures
345	Screw machine products	5.1%
354	Metalworking machy. & equip.	5.3%
355	Special industry machy.	4.0%
356	General indl. machy. & equip.	4.3%
357	Office, computing & acct. machy.	12.5%
359	Misc. machy. except elec.	4.6%
361	Elec. transmission & dist. equip.	5.7%
362	Elec. industrial apparatus	9.3%
366	Communications equipment	15.2%
367	Electronic components & access.	8.6%
369	Misc. electrical machy., equip. supplies, nec.	5.0%
371	Motor vehicles, motor veh. equip.	4.8%
372	Aircraft & parts	7.8%
381	Engineering lab, scientific & research instruments	10.5%
382	Measuring & controlling instruments	9.1%
384	Surgical, medical & dental instr. & supplies	5.2%

Plastic Molding Equipment

SIC	Industry	Percent of Total Capital Expenditures
342	Cutlery, hand tools & hardware	3.7%
343	Heating equip. except electric & plumbing fixtures	4.5%
346	Forgings & stampings	3.4%
357	Office, computing & acctg. machy.	5.3%
358	Refrig. & service industry machy.	4.4%
361	Elec. transmission & dist. equip.	6.2%
363	Household appliances	6.5%
364	Elec. lighting & wiring equip.	8.8%
367	Electronic components & access.	5.1%
369	Misc. electrical machy., equip. supplies, nec.	7.3%
371	Motor vehicles, motor veh. equip.	3.2%
382	Measuring & controlling instruments	4.7%
384	Surgical, medical & dental instr. & supplies	14.4%

Weld - Rivet - Braze Equipment

SIC	Industry	Industry Capital Expenditures
343	Heating equip., except electric & plumbing fixtures	8.7%
344	Fab. structural steel products	13.9%
349	Misc. fabricated products	5.6%
352	Farm & garden machinery	8.3%
353	Construction, mining, oil field & matl. handling equip.	8.6%
355	Special industry machy.	6.8%
356	General indl. machy. & equip.	6.6%
358	Refrig. & service industry machy.	6.6%
363	Household appliances	7.3%
369	Misc. electrical machy., equip. supplies, nec.	4.1%
371	Motor vehicles, motor veh. equip.	6.7%
372	Aircraft & parts	6.2%
382	Measuring & controlling instruments	4.0%

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May 1981

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New Era for Transfer Machines...p. 80

Growth of Quality Circles Is 'Explosive'...p. 96

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It is the purpose of **PRODUCTION** to recognize and to fulfill the special needs of the managers and engineers who are responsible for improving manufacturing efficiency, costs and quality in production metalworking plants, and selected supplier industries.

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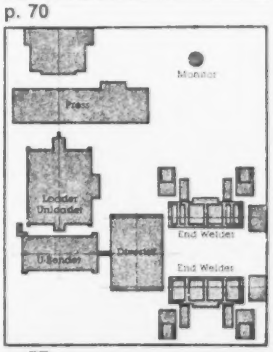

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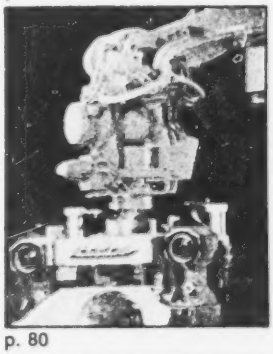

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Cover: CAD/CAM has awesome power. Adequate preparation is vital

Next Month: Spotlight on the manufacturing engineering profession

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No let-up seen for auto and parts makers

DANGER!

Rough Road Ahead

With smaller, more fuel-efficient vehicles coming out of domestic auto plants and more in advanced stages of gestation, it's often assumed that the industry has about passed through its crisis period.

That, however, is not the message contained in an extensive Delphi-type study warning that the foreign invasion will not abate and that the domestic parts production base will significantly erode. Productivity improvements in the domestic industry won't be enough to erase the cost advantages held by the Japanese producers and sufficient money for capital investments by parts suppliers won't be available. It also is problematical whether the necessary improvements in relationships between government, labor and the industry's members can be developed.

The brightest thing about this study is that it has been made and is being looked at carefully by all the involved parties. That it highlights substantial differences in the parties' perceptions of what the major problems are may be one of its greatest values.

The nationwide study was made by the Auto Supplier Action Council (a newly formed arm of the Michigan Manufacturers Association) and the Detroit office of Arthur Andersen & Co. Also participating was the Transportation Systems Center of the U.S. Department of Transportation.

Four separate, independent "panels," consisting of parts suppliers, capital equipment producers, financial organizations, and government people, were surveyed during November and December in two rounds of questioning.

The part supplier panel involved 90 companies, with respondents mainly of chairman, president or vice president rank. Forty-eight capital equipment companies participated and chairmen, presidents and vice presidents were the major sources of the opinions. Officials of 22 financial organizations, mainly banks and investment firms, constituted the financial panel. Twenty-five government officials, mainly in higher-level bureaucratic positions, also participated.

The domestic vehicle producers were not contacted because of their reluctance to divulge financial information and organized labor was omitted because it contains too few separate entities, according to Peter Van Hull, the Arthur Andersen partner who orga-

nized the study.

Before the results of the study were publicly disclosed, its findings along with a number of recommended actions were presented to U.S. Transportation Secretary Drew Lewis and the Michigan Congressmen.

A "Flat" Market. Virtual stagnation of the passenger car and light truck markets in the U.S. throughout the 1980-1990 period and continuation of a foreign vehicle share of the market at 21-24.3 percent throughout the period are the study's two main points.

Growth of the passenger car market is projected as averaging less than 1 percent a year, reaching 11.5-12 million units in 1990. Light trucks will show no growth in the first half of the decade and only minimum growth in the second half. Heavy-duty truck market growth will average 2-4 percent a year throughout the period.

(General Motors Corp., contacted after the study was released, disagrees with the car market outlook; it sees a 2-3 percent annual growth.)

Dealing extensively with the outlook for the parts supplier industry which has been generally overlooked in past examinations of the automotive industry's problems, the study sees the U.S. OEM parts market growing at a 2 percent average rate throughout the decade. However, it also sees the abdication of the market by a number of present suppliers and significant encroachment by foreign producers.

The permanent job loss in the vehicle-producing industry is seen as nearly 200,000 workers from the 1979 level, while employment in auto parts supplier plants will decline by up to 400,000 persons.

The problems for the suppliers and the vehicle producers can be extrapolated from the survey's detailed findings into four types: technology/productivity problems, capital investment problems, relationships problems, and perception problems.

TECHNOLOGY/ PRODUCTIVITY

All four panels believe the Japanese vehicle manufacturers lead U.S. manufacturers in production methods and manufacturing technology by about three years. They see a close intertwining of Japanese labor relations, including such participative methods as Quality Circles and few divisions of labor, with the productivity advantage. The part supplier panel, in fact, rates Circles as the most important method by which U.S. productivity could be increased. An interesting comparison of where our manufacturing technology is perceived to stand versus that of Japan and Europe is contained in the chart below.

Looking at themselves, the U.S. parts producers forecast they could achieve a 10 percent increase in productivity by 1985 and again by 1990 through the use of new equipment and tools. This forecasted improvement is only half of what the capital equipment panel believes could be accomplished.

Identifying the forms of automation that could lead to this improved productivity by 1985, the part supplier group ranks robots as most important, while programmable controllers, automated assembly machines and automatic loaders/unloaders come next in importance, followed by automatic inspection, then by transfer lines and flexible machinery systems.

The capital equipment panel ranks robots, programmable controllers and automated assembly machines as the greatest potential contributors to improved productivity; it places automatic inspection and transfer lines as of next importance; these are followed in importance by automatic loaders/unloaders and flexible machinery systems.

The parts suppliers think a 10 percent reduction in setup times could be obtained in each half of the current decade. The capital equipment producers see the possibility of a much greater reduction—at least 35 percent by 1990. Numerically controlled machines are the equipment producers'

MANUFACTURING TECHNOLOGY
U.S. COMPETITIVE POSITION VS. JAPAN AND EUROPE

Percent of Responses

U.S. Position vs. Japan	Parts Supplier Panel	Government Panel	Financial Panel	Capital Equipment Panel
U.S. lead	19%	19%	28%	33%
U.S. lag	78	69	72	50
Equal	3	12	0	17
U.S. Position vs. Europe				
U.S. lead	41%	38%	76%	50%
U.S. lag	56	24	12	21
Equal	3	38	12	29

prime solution to setup-time reduction, followed by throwaway or preset tooling, pallet shuttle machines, rolling die bolsters and die set trucks.

In a separate earlier study last year by Arthur Andersen & Co. with all U.S. vehicle producers and 12 key parts suppliers, possible revisions in plant systems were calculated to provide as much productivity improvement opportunity as new equipment and tools—10 percent by 1985 and an additional 10 percent by 1990.

CAPITAL INVESTMENT

U.S. vehicle manufacturers are expected to spend $14 billion a year (in 1980 dollars) until 1985 for capital equipment and facilities.

The domestic parts supplying industry was estimated to have spent $2 billion for these items in 1980 and is predicted to increase that expenditure by a 2 percent annual rate during the decade.

The parts supplier panel looks for a 16 percent annual growth rate in capital expenditures by the vehicle manufacturers through 1985 and a 12 percent rate from then until 1990. Their own annual increase in capital expenditures is predicted at 10 percent in the first half of the decade and 8 percent in the last half (an actual decline in view of inflation expectations). A shift away from physical plant (25%) and toward new machine tools/tooling (60%) is expected by this group.

The capital equipment panel looks for even less equipment investment by the parts suppliers.

This panel also expects the proportion of machine tool industry sales to the automotive industry and its suppliers to decline from the 48 percent of total in 1980 to 38 percent (vehicle producers 29%, suppliers 9%) of total machine tools sales in 1985.

The parts industry's sourcing of machine tools from foreign manufacturers is expected to double by 1985, to about 20 percent. The vehicle producers are expected to increase the proportion of purchases of foreign-made machine tools from a present 10 percent to 13 percent by 1985.

The parts supplier panel and the capital equipment panel concur that lower cost and innovative or superior-quality machines are among the primary factors encouraging purchase of foreign-built machine tools. Shorter leadtime is considered the most important factor by the capital equipment panel and the least important by the parts supplier panel. Lower cost is ranked by the parts supplier panel as the most important advantage, and the builder group ranks it as second in importance.

There's little agreement between the groups on what the problem is

The part supplier panel forecasts a change of their industry from a medium-risk and return (on investment) industry in the 1970s to a high-risk, low-return industry in the 1980s. A rate of return of 12-13 percent on new investments is projected.

The financial panel forecasts even lower returns on investment in the automotive industry as a whole (11% in 1985). Seventy-nine percent of the financial panelists consider the major investments needed by the industry to be economically feasible.

RELATIONSHIPS

All panels agree that the business climate for the automotive industries in Europe and Japan is improved by the joint industry, labor and government cooperation that exists in those countries. All panels likewise agree that providing investment incentives should be a primary U.S. government policy role for improving the international competitiveness of U.S. vehicle and parts manufacturers. The panels all agree also that relaxing government regulations is critical to our vehicle producers.

The need for an improved labor/management relationship that will foster more involvement by workers in decision-making and will eliminate much of the elaborate system for division of labor in U.S. plants is heavily stressed in connection with the industry's productivity problems. Also mentioned is the need for wage restraint and willingness to share business' risk through profit-sharing schemes.

DIFFERENT PERCEPTIONS

Many significant differences show up in the perceptions the various panels have toward the nature and the severity of the industry's problems. Calling attention to these differences may be one of the study's most constructive aspects.

The government panel is the most optimistic about the industry's outlook in terms of vehicle sales and import vehicle penetration. The financial panel is the most pessimistic.

The government panel sees capital investments as holding most promise for improved operating conditions in the industry while the other panels focus on the need for better relations between labor, industry and government and for new manufacturing systems/approaches.

The government panel ranks regulations as significantly less detrimental to the industry than the other panels do.

How rough the road ahead is may be a matter for some disagreement, but it surely will be worse if the parties can't get a cooperative act together.

Howard C. Tuttle □

June 1981

PRODUCTION

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It is the purpose of **PRODUCTION** to recognize and to fulfill the special needs of the managers and engineers who are responsible for improving manufacturing efficiency, costs and quality in production metalworking plants, and selected supplier industries.

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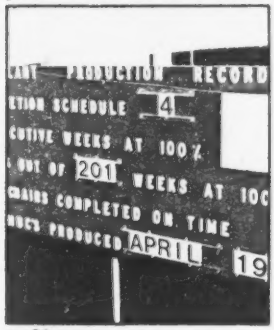

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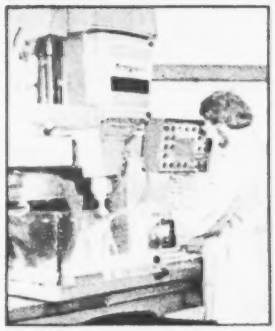

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MRP—What Does It Take To Make It Work For You?
Manufacturing Resource Planning can provide the mechanism, when coupled with total management commitment, to solve many manufacturing problems associated with scheduling and inventory levels. Two users explain MRP's installation and benefits

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Careful planning and selection of highly efficient machine tools helped Williams Research Corp.'s expanded plant bring a new model turbofan engine into production three months ahead of schedule

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100% Quality for Hard-to-Handle Parts
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Cover: Tom Westman, our "manufacturing engineer" model, actually is the husband of our Director of Graphic Design

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The Manufacturing Engineer

In the Spotlight

On him (or her) depends a company's capability to produce current products better and lay plans for how tomorrow's products will be buil

At one time, industry had to home-grow its own "master mechanics" through an apprenticeship and then season them in the sch of hard knocks. Later, engineering schools took over. But now, the

"When a person has responsibility for dealing with today's problems along with responsibility for tomorrow's, he never has a chance to look at tomorrow."

This statement sums up the most common complaint of manufacturing engineers. Said in another way, manufacturing engineers consider "fire-fighting" the major part of their work, and they don't feel their organizations give them time or support for development of the large-scale manufacturing improvements that everyone says will be present in "the factory of the future."

As a partial solution to this complaint, the vice president of manufacturing for a high-technology industrial company says: "We're trying to identify obsolescence both in terms of ability and technology and then bring into play not generalists but experts to initiate new projects."

Where those experts will come from is another problem, as expressed by a veteran university professor: "I find the quality of the graduate in manufacturing and/or design has deteriorated markedly in the last five years and see little or no hope of reversing this trend in the near future. . . .I shudder to think what will develop in the M.E. (mechanical engineering) program when we fuddy duddies die off. The new professors have little or no knowledge of manufacturing."

The executive director of an executive search firm well-respected in manufacturing circles comments: "If I were to point out the most common weakness in manufacturing engineering or industrial engineering candidates it would be in lack of personal marketing skills—selling their own accomplishments. This goes hand in hand with a weakness in communication skills."

"Industry isn't attracting the best engineers with MBA degrees. They're going where there's more money—finance or consulting," says a top-flight consultant. (Current salary levels of mechanical and industrial engineers are shown below.)

As these five different viewpoints suggest, the manufacturing or industrial engineer is a vital but

The Current Salary Picture

Of the ten most sought-after engineering disciplines, mechanical engineers now rank third and industrial engineers rank sixth coast to coast, according to a survey conducted by Fox-Morris Personnel Consultants, Philadelphia.

The demand for MEs is 13.4 percent higher than a year ago, while 9.6 percent more IEs are being sought.

At the top of the "big ten" list of engineering specialties are electronics/electrical engineers, enjoying a 14.1 percent rise in demand; at the bottom of the list, with an 8.7 percent increase are metallurgical engineers.

Salaries being offered to and accepted this year by the MEs and IEs, in three different experience levels, are as follows:

Country-wide	Just Graduated Avg. (and Avg. High)	2-5 Years Exp. Avg. (and Avg. High)	Management-level Exp. Avg. (and Avg. High)
Mechanical engineers	$21,450 (22,500)	$27,450 (30,100)	$37,400 (42,000)
Industrial engineers	$19,050 (20,900)	$25,400 (29,100)	$35,050 (40,600)
Geographical Location			
Philadelphia Area	MEs $23,000 IEs $23,000	$28,500 $28,700	$40,000+ $35,000+
Atlanta Area	MEs $22,000 IEs $20,600	$29,300 $26,000	$41,100+ $38,400
Boston Area	MEs $22,000 IEs $19,500	$28,000 $27,000	$35,000+ $37,000+
Detroit Area	MEs $19,000 IEs $18,000	$25,000 $24,000	$40,000+ $35,000+
Los Angeles Area	MEs $21,650 IEs $19,450	$27,700 $25,800	$37,800 $35,500
Houston Area	MEs $22,100 IEs $20,750	$28,800 $26,500	$39,000+ $38,000+

imperfectly configured cog in today's manufacturing system. The student in a curriculum leading to a job as a manufacturing engineer has little information on which to base his career choice. And after he's been in that job for a period of time, he feels he's often saddled with clerical or technician tasks that don't require his full abilities. Furthermore, to win promotion he must develop and demonstrate skills that weren't part of his degree requirements.

What those comments don't reflect, however, is the intense satisfaction most manufacturing and industrial engineers are getting from being in these seemingly ill-formulated professions.

The positions' satisfaction-providing attributes, the variety of challenges, and some of the changes taking place in emphasis are conveyed in a survey made of PRODUCTION's readers and in the accompanying profiles of six young industrial and manufacturing engineers. Ranging in age from 27 to 39, these men were selected for spotlighting from among PRODUCTION's readers not because of particular accomplishments or career objectives but because they are working in representative progressive companies and they reflect the variety of educational backgrounds that typically characterizes the manufacturing/industrial engineer.

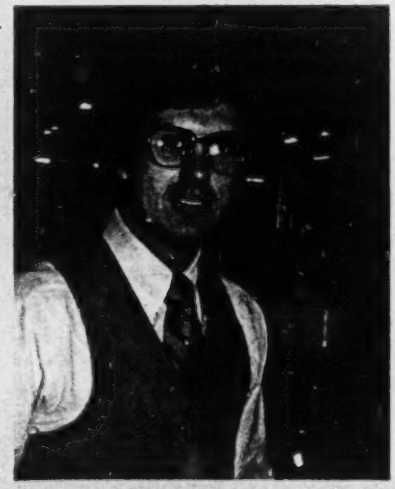
Their mobility, experiences, and apparent ease of shifting into many functional areas in their companies suggest that the manufacturing/industrial engineer is, as one knowledgeable recruiter calls him, "the modern-day Renaissance man."

A Lesson from Space? In the right kind of organizational environment, it is people like these who will cast the shape of the factory of the future.

It is generally acknowledged that the greatest significance of the "Columbia" space shuttle's successful flight was the amazing ability of NASA and Rockwell, the prime contractor, to design, organize and manage an incredibly complex system. The technologies represented were awesome and the training and skills of the participants were vital components, but putting the elements together into a cohesive, dedicated whole was the program's supreme accomplishment. Industry's job if the much-talked-about systems for computer-integrated manufacturing can be brought into being will be similar. Yet, for the most part, it is the hardware and technology that gets the emphasis; the required manufacturing system and the needed people skills receive minimal attention.

Wickham Skinner, professor in the Harvard Graduate School of Business Administration, addressed this crucial aspect of the so-called factory of the future at last winter's annual meeting of the Production Engineering Div. of the American Society of Mechanical Engineers.

"It is clear," declared Professor Skinner, "that the availability of equipment and mechanisms has far outrun the ability of the modern factory system to absorb these new technologies. Somehow management in the manufacturing world has apparently been unable to fully assimilate the new technologies which engineers and scientists have made available. . . .We have the ironic situation of industry loaded with unused technology yet in trouble in terms of competition, costs, flexibility for volume and product change, return on investment, ability to attract young, able people, 'blue-collar blues,' layoffs, unemployment, strikes, plant closings and a gradual shift from man-



Profile: John J. McGara

Age: 32
Title: Manager of Industrial Engineering, Van Dyke Plant, TRW Michigan Div.
Location: Sterling Heights, MI
Education: Graduate of Ohio State University in Industrial Engineering
MBA-Finance from University of Toledo
Marital Status: Married

Already experienced far beyond his years, John McGara is on the fast track in the high-pressure atmosphere of an automotive industry supplier.

He got his MBA in Finance at night while working as an industrial engineer at City Auto Stamping Div. of Sheller-Globe in Toledo, OH, and at Elastomer Products Div., Gould, Inc., and joined the industrial engineering staff of the Van Dyke Plant in suburban Detroit of TRW Michigan Div. four and a half years ago.

A year and a half later, he was promoted to industrial engineering manager of the approximately 800-employee plant where he became responsible for developing the facility's capital investment programs at a boom time. Now, he's in charge of shaping the plant's cost improvement programs, the largest in its history.

As this has gone on, the plant's product mix has been undergoing significant changes—the OE busi-

ufacturing to service industries."

His fundamental question was: Will the factory of the future always remain "in the future"? And his answer was "yes" unless a change of critical importance takes place in the way manufacturing is managed.

Its emphasis, he said, must change from taking the *operating* point of view, based on daily, weekly and yearly positions, to developing the long-range manufacturing strategy and structure that will enable the total organization "to get out ahead of the problems, away from a reactive mode."

In making this analysis, Professor Skinner concurs exactly in what our survey of readers in manufacturing engineering positions told us is the major problem. Misplaced priorities dictate that much of their work is of the "fire-fighting" kind.

However, the way the jobs of several of the young men we profiled have recently changed is encouraging proof that in some companies the structure, strategy and personnel for breaking away from the traditional short-range concentration are being developed.

Involvement of industrial and manufacturing engineers with upstream designing for producibility is a key change. One of these men calls it "automating your product and not just your process" and emphasizes the importance of the difference. Another stresses the search for ways of compressing the time span of the design/manufacturing cycle, and another says his plant gets a "double whammy" when the new equipment specified is conventional and the flexible automation he thinks is needed cannot be economically justified under current payback requirements.

That significant changes in traditional manufacturing methods and systems are occurring were indi-

The Goods and Bads of Mfg. Eng.

The outstanding job-satisfaction characteristic of the work of a manufacturing engineer is: "You get the chance to take a project from beginning to completion—you get a great sense of accomplishment."

The two largest frustrations are: "You're always fire-fighting," and "Too much clerical-type work."

A group of PRODUCTION's readers received an open-ended questionnaire asking what aspects of their work they liked best, and least.

Among major favorable comments were: "Immense variety of work." "Challenging." "Doing hands-on work." "Using new, innovative ideas." "Skill is portable." "Opportunity for contact with outsiders and professional groups." "Chance to sell ideas and sell self." "Large company permits experimentation."

Major sources of frustration included: "Input is allowed too late after the product is designed." "Blamed for product costs but not allowed 'say' in product design." "Too few managers with mfg. eng. background." "Doing work a technician should do." "Little done to help become more productive—no computer terminal, have to beg for supplies, lack of quiet work space." "Not enough money for R&D—firefighter." "Company not willing to take risk in new mfg. methods." "Need dual ladder for advancement—one in management, one in area of specialization." "Too much emphasis on educational attainments."

On balance, everyone of our respondents said they enjoy the work.

ness in high-volume, long-run steering gear components has declined while the aftermarket requirements in lower volumes and greater variety have increased. New approaches in costing as well as in processing and material handling have been required.

Industrial Engineering, as the profession is practiced in this and several other divisions of TRW, is the umbrella organization for all capital resources planning as well as the traditional industrial engineering functions of work standards development and measurement. One section in the department establishes the total organization's budgets, standards and new product costing. The second is responsible for improvement of the plant's materials handling operations—an area currently receiving major attention. A third responsibility is capital investment planning, justification and proposal preparation.

With respect to his in-college preparation for this challenging work, John is high in his praise for the Industrial Engineering program at Ohio State with its heavy hands-on emphasis on manufacturing processes. He also is enthusiastic about the MBA program, "which I thoroughly enjoyed."

He sought the MBA degree because "working as an engineer in my discipline it's hard to see the total picture; your focus is fairly limited at that level." The MBA program also "gave me good experience in making presentations to groups and selling my ideas," he notes.

Still developing his skills in that area, John says he's currently taking a Dale Carnegie course under the tuition-refund program offered by TRW to its employees.

Where will John McGara be in five years?

"My career interest is in operations management," he says. "I want to get a plant managership in TRW within five years. Then I anticipate some lateral moves that will take me out of the IE area and broaden my experience. Further down the road, say within ten years, I'd like a shot at a division general managership."

cated in two articles appearing in PRODUCTION last month. "New Era for Transfer Machines" described what is called industry's first integrated transfer machining system with robot loading/unloading and automatic material handling. The system is in operation at General Motors' Three Rivers, MI, Hydra-matic Div. plant. In "A Turbulent Technology Strikes at Cost/Time Barriers," the experiences of eight companies in installing CAD/CAM systems were described.

Several of the new technologies needed for "the factory of the future" are encompassed in these examples. The literature also contains numerous listings of what these technologies are likely to be. A well-detailed one is that developed by Battelle Columbus Laboratories for the Society of Manufacturing Engineers and presented in the 1979 report on "The Manufacturing Engineer—Past, Present and Future." Professor Skinner cites a list developed in 1980 by Joel Goldhar and A. Avakian for the National Research Council.

What mainly is lacking with respect to these technologies, according to Professor Skinner, is management pressure to put them in place. He identifies six managerial roadblocks:

- "Short-term financially dominated point of view in top and manufacturing management, with reward systems based principally on performance against annual budgets. . .
- "High hurdle rates for investment paybacks.
- "Top management inexperience in manufacturing and a more typical financial/marketing orientation.
- "Risk aversion by corporate executives relative to major new innovative investments.
- "Managers in the manufacturing sector have typically not been sufficiently innovative, daring or shown the leadership necessary for proposing major new high-risk factories, or to break away from the safe, tried-and-true.
- "Too many manufacturing managers focus on the short-term: meeting the monthly schedule, bogeys for quality and delivery, and labor/personnel problems. They lack a strategic point of view."

Not immune from his criticism are those engineers who also are unwilling or unable to effectively utilize leading-edge technologies, which will "rapidly make outdated a generation of technical people who cannot cope."

Heartening Signs. However, says Professor Skinner, a "new breed" of manager able to dismantle these roadblocks and to instill new philosophies about manufacturing is emerging.

"This new breed is competent not only in technology but in management. S/he focuses on design and operations with equal facility, has a broad viewpoint that copes not only with technology but coordination, systems and people. They focus on entire interrelated systems and operations and not just on individual equipment or departments or functions." However, the "old breed," he says, is predominant and "the 'new breed' is too limited in number and youthful in age and organizational level in most organizations yet to tip the scale." Yet, in many companies, he reports,

Profile: Garnet W. Hizzey

Age: 39
Title: Manufacturing Engineer, 707/727/737 Div., Boeing Commercial Airplane Co., Seattle
Education: 5-year student-apprentice, Rolls Royce Ltd.; graduated manufacturing engineer. Two years at Cranfield Institute of Technology, Bedford, England; graduated Master of Science in Production Engineering
Marital Status: Married, three sons

Garnet Hizzey was recruited by Boeing in London immediately after his graduation from Cranfield. He moved to Seattle and spent his first five years in detail planning—planning the manufacture of a myriad of machined and formed parts for airplanes. During this period he also began to work with computers in manufacturing planning and management.

Since 1971, Garnet has spent most of his time in airplane assembly and installation. But it has not become routine. He has been a member of task forces that have worked on product and producibility problems at Vertol Div. in Philadelphia, and at Boeing plants in Wichita, KS, and Portland, OR. Based in Seattle the whole time, Hizzey explains his participation in these teams:

"I think I have been selected because of my broad technical background and experience in manufacturing, plus the fact that I enjoy working with people. I seem to be able to get things rolling. I have drawn an uncommon number of assignments such as these. It certainly does round out my experience, because I get into all phases of production and manufacturing, many of which I would otherwise have nothing to do with."

At present, Hizzey is heading up

"moved by the engine of change, the focus is clearly moving back to manufacturing after 20 years of high cost, slumping productivity, poor quality, unstable labor relations and the inability to compete. The pressures are economic, and there is leadership being developed and momentum being created."

Among companies where the new strategic manufacturing approach to manufacturing management, deemed necessary by Professor Skinner, is being developed is TRW, Inc., Cleveland.

The occupant of the newly created corporate position of vice president-manufacturing, Gus Schrader, contends that some organizations are more accepting of the necessity for change than others. Willingness to take a risk is a basic difference.

Some companies, he suggests, "have tunnel vision on how to get 'from here to there.' Whatever they want to do, it must be done with zero risk." At TRW, creation of an environment for innovation and encouragement of acceptable risk-taking are stressed.

"Innovation," he declares, "is what will keep us at the head of the pack." The broad-based human resources programs in the company aim, in part, at equipping people at all levels both to initiate and to welcome change. "We put a lot of effort into helping people grow," he emphasizes.

When the suggestion was made to him that the company appears to be placing a strong emphasis on youth, as indicated by the rapid progress of one of the men profiled (see p. 72), Schrader, a veteran of 15 years at TRW, much of it as a vp in operations, responded: "I don't think our emphasis is on youth.

Hints on 'Getting Ahead'

- ☐ Analyze area(s) of weakness and strengthen it (them). Communication skills and human relations skills are particularly important.
- ☐ Learn how to present right kind of information. Emphasize benefits to company of proposed action/equipment purchase. Do the same in "selling yourself"—capitalize on the dollar benefits of your work, not on your specific responsibilities.
- ☐ Work at finding out about other departments/functions within your company.
- ☐ Keep your options open. Avoid being pigeon-holed both in areas of interest/expertise and in types of work experience.
- ☐ Take advantage of every available opportunity for self-development.
- ☐ Use your professional society(ies) for further knowledge in your specialty, contacts, prestige.
- ☐ Look, think, act successful.

a team that's working on the engine strut for an elongated version of the twin-engine 737.

"Because the strut is short and dense, we'll have access problems in assembly. We'll be able to do very little drilling of holes at that point. We'll have to produce full-size holes and holes with coordinated locations so we can manage the final assembly problems. We expect we'll have to develop some new equipment," he adds.

Hizzey's team has six from manufacturing engineering plus others from design, tooling, materials, industrial engineering, quality control and fabrication.

"This multidiscipline approach to the problem is important," he stresses. "Because of the nature of the task, manufacturing engineering has assumed the chairmanship, but we are all working on the same problems at the same time. Processes will include machining, welding, heat treating and varieties of bonding and fastening.

"Since weight is more critical now than it has ever been, composite materials and designs must continuously take weight into consideration. Assembly adjustment allowances have been designed out because they add weight. Accuracies are greater; tolerances no longer are ±.030 in. and ±2 degrees. They now are ±.002 in. and ±¼ degree," he reports.

His early work with computers is constantly being upgraded in the course of requirements of the job. "We are thoroughly computerized at Boeing."

About his job, Hizzey says: "I like my job! Heck, I wouldn't change it for anything. As a matter of fact, there's not much about it I don't like. I've been fortunate—I've had a lot of good assignments.

"With so many high spots, the low points occur from doing something mundane. I do find that our strict adherence to the structure and the discipline of our computer methods appears at times to be a nontechnical constraint, and it is not stimulating. But once the bookkeeping end of it is done, then the rest of it is fine," he remarks, adding: "What we are doing here offers a good opportunity for any good young person with a technical training and a manufacturing interest. We have more exciting challenges than we have good people to answer them."

Challenges seem to suit Hizzey. He climbs glaciers and mountains for sport.

It's on excellence. Excellence is what is going to get us into the future that we're visualizing for this company."

In everything the company's doing, he asserts the thrust is for long-range benefits—"growth in earnings, opportunities for our employees, role of corporate citizenship.

"We aren't limiting our thinking to short-term, bottom-line results."

Educational Gaps. In the early stages of the interviewing to produce this article, PRODUCTION's editors were looking to see whether manufacturing/industrial engineers several years out of college were in danger of being obsoleted by new hires who presumably had better knowledge of new manufacturing technologies.

What showed up instead is the woefully poor preparation students receive at most colleges and universities for manufacturing engineering careers. Glaringly missing, too, is guidance in career choices.

A scathing indictment of most schools offering a BS in Mechanical Engineering has been written by Prof. Jack T. Kimbrell, Dept. of Mechanical Engineering, Washington State University, based on a large-scale survey he made in more than 300 companies, discussing the ME's educational preparation with the person's immediate supervisor.

Looking at 25 topics believed needed by engineers—e.g., technology, materials, processes, reliability, communication, economics, etc., he found the engineers inadequately schooled in most of them. With respect to technology, he says: "The engineer's knowledge of hardware basic to all industry is very deficient." Re manufacturing processes, "the new engineer is by and large unaware of modern manufacturing processes. More disturbing is the fact that they have little or no appreciation of the influence of the process on the designs." Re metrology, "modern techniques for precision measurement of dimensions are virtually unknown." Re economics, "accounting procedures seem to be a mystery."

It now takes twice as long, he believes, to bring new engineers up to speed in industrial jobs than it did ten years ago. He concludes by saying that outside of California's "Silicon Valley" and a very few industries, "this surveyor found that they (ME graduates) are simply helping to maintain production levels and occasionally make improvements in products or processes. They are 'earning their keep' but are doing very little to reverse the rapidly deteriorating position of the United States as a leading industrial nation."

Profile: Larry Hoke

Age: 35
Title: Electronics Engineer, Truck Axle Div., Rockwell International
Location: Newark, OH
Education: Columbus (OH) Technical Institute, Associate degree in Mechanical Engineering
Marital Status: Married, two daughters

Since he joined Rockwell, right out of school, Larry's progress has been through a variety of departments and assignments rather than straight-line growth. After completing a four-year apprenticeship as a tool designer, he was a journeyman tool designer for two and a half years. Next, he moved into NC programming where he spent three years.

He then was chosen to be the line foreman of a Flexible Machining System when it was being installed and started up. "This job was a real challenge," Larry admits. "The Kearney & Trecker system originally had 11 machines in it. We since have added two Modu-Lines and removed three Turn-12s. All of us were new to the system—the operators, the maintenance personnel and supervision.

"Working with such a system is a lot different from working with stand-alone machine tools. You must have intimate knowledge of the computer and of the software. You have to know what must be done to keep the entire system running, and you have to know how to diagnose trouble—to know whether it is a machine problem or a control problem. This, of course, is in addition to the job of getting production out."

Hoke now has moved from direct supervision on that line to electronics engineering for the entire plant. His responsibility, and that of the four electricians who work with him, is to keep the plant's 48 NC machines running.

Hoke's short-range goal is to move up into maintenance management. 'I'd like to be general maintenance foreman or to have moved into machine design or project management in five years, specifying and working on new equipment for the plant. I have applied to Franklin University in Columbus and plan to enroll in the fall.

"The major reason I like my current work is that every day represents a new challenge. There is little repetition. Also, I get to work with all of the latest electronic control technologies."

What does Hoke like least about his job? "Getting called at three o'clock in the morning to come in and handle an emergency."

An exception to the generally inadequate knowledge of what industry needs usually is at schools that offer a co-op program, where an introduction to the real world of manufacturing occurs on the job and in the orientation toward real-life situations that most of the schools' instructors have.

For graduates from most non-co-op schools, the choice of company/industry/job is mostly accidental and the first few years are "make-or-break," with the individual's self-motivating characteristics being all-important.

Some companies, such as TRW, Inc., provide an "intern" program, giving the new hires real responsibilities but moving them through a variety of job situations.

The ongoing educational opportunities of various kinds available to manufacturing engineers appear to be of greater benefit, by and large, than the undergraduate degrees they've received. The degree, in most cases, got them the job. But it stopped far short of giving the knowledge to progress in their organizations. To the credit of the Society of Manufacturing Engineers, its Education Foundation is helping provide funds, equipment and advice to many schools to upgrade the manufacturing processes curriculum.

Without the in-house courses, those seminars offered through appropriate professional societies and by various private organizations, and the financial support by their companies for further on-campus study, the manufacturing/industrial engineer—and his/her company—would appear to be seriously lacking in the knowledge and skills the future demands.

The educational system's vacuum is so obvious it has created an important new business opportunity for many previously non-educational organizations. One of these is the market research firm of Frost & Sullivan, Inc., New York, which this year established F & S Institute, Valley Stream, NY, under the management of Frank Massa. Its first programs are six-day-long workshops for designers (and users) of production equipment. Attendees bring actual problem-solving proposals from their companies for development at the workshop. At the first of these workshops a couple of months ago, projects included an automated assembly line incorporating robots, and a laser inspection station. Additional workshops are scheduled for Sept. 14 and Nov. 16.

Job Opportunities. All of the currently popular buzz words—"reindustrialization," "productivity," "cost improvement"—are the words of the manufacturing and/or industrial engineers' song. *(continued)*

Profile: John J. Demmer

Age: 27
Title: Process Engineer, John Deere Engine Works, Deere & Co.
Location: Waterloo, IA
Education: BS in Mechanical Engineering, University of Iowa Working on Masters degree in Engineering at Iowa State
Marital Status: Married

When a particular new boring machine is released to production in the John Deere Engine Works in the next few months "it'll have my 'name' on it," says John Demmer. As the process engineer responsible for that particular operation, John says the machine has been his project for a little more than a year and a half—from its selection, cost justification, request for appropriation, through to fixtures and tooling, try-out on the floor, and arranging for Quality Control's check-out of its precision capabilities.

John has been with the Deere Engine Works in Waterloo a little over two years. Upon graduation from the University of Iowa as a mechanical engineer, he went to work as a process engineer at Ford Motor Co.'s Sterling Heights, MI, plant processing the equipment for automotive drive shaft components. But the grass looked greener in his home state of Iowa so he went back there in April 1979, to a "showcase" diesel engine plant that has been in operation for about five years.

At this stage of John's career, his opportunity to see at close range both the product engineering and the manufacturing engineering processes is an advantage. "With a mechanical engineering background, I'm leaving myself open to go in either direction," he admits. John is half way through a Masters of Engineering program at Iowa State, which he thinks will help qualify him at some future date for an engineering management position.

Deere is providing him with abundant opportunity for development through its in-house programs, tuition payment for his

Masters Degree study and encouraging attendance at seminars when they are appropriate to his job.

Manufacturing technology is changing very rapidly, he notes, and a source of some frustration is the feeling that "if you go out and buy a process now by the time you get it implemented it will be outdated," he remarks.

More flexible, more adaptable machines, therefore, are sought but these "are a lot more expensive than the ones they're replacing, so we're faced with some very tough decisions," he laments.

Developing the facilities (including human ones) to make products better and cheaper is these professions' reason for being.

Warren L. Halperin, executive director of the international executive search firm of MCS, Newport Beach, CA, a division of McSweeney & Associates, gives this analysis of the current opportunities and career ceilings for each of these professions.

"Historically, the industrial engineer has constituted the unsung hero of the manufacturing company. In the executive office, the image of the industrial engineer has been something akin to that of the 'green eye shade' accountant. During the past years we have seen a trend developing with the industrial engineer perceived in a new, truer light.

"The well-rounded industrial engineer has had experience in manufacturing techniques, EDP systems, organizational structure, labor utilization, facilities planning and utilization, transportation and distribution, and, in many cases, financial systems. His expertise cuts across most corporate functions.

"Combined with this multi-discipline experience is often an improved people management skill. This management skill comes as a result of his being an 'internal consultant' rather than an operations executive. The operations executive can effect necessary change implementation by simply mandating it to the subordinates who work directly for him. The IE cannot mandate change but must work through persuasion. He must be able to market his recommended change and win support for it. Hence, he works through motivating others, a key management tool of the executive office.

"Combining these factors makes the well-rounded IE a multi-faceted management leader, relative to an individual coming out of Finance, Marketing, Product Design, or Production only.

"We see a growing cognizance of the IE by top management as a result."

For the IE, Halperin has some hints with respect to educational preparation: "The ideal educational background would be a BSIE (or BS Engineering) combined with an MBA (preferably in Finance or General Management). The combination of an engineering undergraduate and advanced business degree provides a balance of the quantitative and the qualitative. In lieu of an advanced business degree, an MS in Engineering would be helpful. The nature of schools is also important but not critical. Doctorates are perceived as a negative in many cases; corporations perceive them as being often too theoretical rather than practical. The BSIE/MBA has a good edge in future career opportunities over the BSIE."

Halperin sees more of a career ceiling on the manufacturing engineer. "Generally, we find it exceedingly difficult for a production engineer to reach the top corporate spot. Most corporate heads having a production engineering background have either started their own company or are within a corporate environment with historical inordinate production

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Profile: Michael J. Ryan
Age: 27
Title: Production Engineer, Data Systems Div., Hewlett-Packard
Location: Cupertino, CA
Education: University College, Galway, Ireland—Bachelor's degree in Industrial Engineering
Santa Clara University—Now studying for Master's degree in Electronics Engineering
Marital Status: Married, wife is software engineer at HP's Santa Clara Div.

Electronics is Mike's avocation as well as his job. Born in New York City, Mike moved with his family to Ireland when he was six years old. As a boy, he was interested in electrical and electronic devices, and in college computers captured his main interest.

When he graduated from college in 1975, his first job was that of a computer programmer at a service bureau. He then worked for two years as a production engineer and then a manufacturing engineer, helping to establish a plant in Ireland for a division of Westinghouse. His projects included equipment and methods for assembly lines, a sheet metal fabricating plant and CNC tools.

"In 1978, I decided I wanted to be in the computer and electronics industry, so my wife and I moved to California. I interviewed with and was hired by Hewlett-Packard as a production engineer in the Palo Alto manufacturing division.

"After about a year, I moved to the Data Systems Division, working primarily on the manufacture of power supplies for computers. Right now, I am working on some products that will be introduced in about a year. My task is to help develop manufacturing and testing procedures for the new products, but I also am part of a series of producibility reviews in which we

work with the product developers to help improve the producibility of the products."

With respect to his goals and objectives, Mike says: "I hope I can move into research and development, but not for several years. When I finished college I had aspirations to move up in

problems. The 'Great American Dream' is still alive and well for the brilliant production engineer who can find a better way to build a needed product. But within an established corporate setting, the top floor corner emphasis will remain among the marketing and financial strategist types.

"However, heading up production in a major corporation isn't half bad, either," he exclaims.

"To reach career potential in manufacturing engineering," he adds, "the undergraduate degree is most important with advanced technical degrees an asset. The advanced degree is helpful but the lack of same is certainly not a significant liability."

An easily overlooked career opportunity for aggressive manufacturing engineers is spotlighted by Halperin.

"If an individual is financially motivated, extroverted, with a high energy level and aggressive, consulting firms offer exceptional opportunity," he points out.

"There are a number of outstanding manufacturing/oriented management consulting firms. These consultants may be ACME firms (Assn. of Consulting Management Engineers) or 'Big 8' CPA firms, the eight largest public accounting firms in the world. All of the Big 8 provide manufacturing consulting."

These organizations, he says, "have capable and qualified staffs who can consult on virtually any problem in the manufacturing process. Compensation is typically a good deal higher than in industry. As an experienced executive consultant, a person can reasonably aspire to a six-figure income. They also can reach substantial income levels at a relatively young age."

His company currently is conducting searches for BSIE/MBAs with prior manufacturing consulting experience at $60,000 or more compensation levels. Experience can be as little as 10 years.

He notes, however, that consulting work is not all roses! "To go into consulting requires above average communication skills. The hours are long and the travel is greater (than in industry). But so are the rewards."

Should I Change Jobs? Nearly all sizable manufacturing companies are looking now for manufacturing or industrial engineers. A vp-industrial relations at an East Coast aircraft/avionics firm says he has six requisitions for manufacturing engineers on his desk right now. The display classified ad sections of newspapers and professional journals bulge with attractive-sounding positions.

The greener-grass-on-the-other-side-of-the-fence syndrome, however, should not be forgotten. As our profiles indicate, opportunities for these men have abounded within their companies.

Looking at the pros and cons of your situation is a better first exercise than drooling over what some ad writer says his candidate-seeking company offers. PRODUCTION's Contributing Editor Dr. Ted Pollock,

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manufacturing management and then into general management. Now I realize that I am more inclined toward research and development than I am toward management. I intend to keep working in manufacturing for a while. I still have much to learn, especially in our business where the technologies are changing so rapidly.

"Actually, I see our industry paying increasing attention to producibility in the future, whereas in the past our primary concern was in pushing the edge of technology with our products. As we now are faced with increasing cost competitiveness in the marketplace, manufacturing engineering finds itself with increasing emphasis and stature in our company.

"Introducing new products today is a team task. We have many meetings, with research and development, materials specialists, manufacturing engineering and others all sharing and contributing to the successful product introduction.

"But the problem is that the state of the art in electronics equipment moves so rapidly that we can't count on more than about two years for the product-development cycle. We must find ways to collapse the time between discovery and successful manufacture. Eventually, I want to take my manufacturing skills and knowledge into research and development so that at the same time the products are evolving producibility is made an original consideration and product feature."

Can he do this at HP? "Yes, I am confident I can. One of the very important aspects of our company is that every employee is an individual. We have open doors when it comes to expressing our ideas, and management is anxious to help us in attaining our personal goals and in helping us contribute to the company's goals. It probably is an unusual company in that regard. I am positive that if my objectives make sense, the company will help me fulfill them."

Ryan feels that his industrial engineering education was the best possible one for him. "Industrial engineering at Galway is a very general education. I studied electrical and mechanical engineering, operations research, accounting, industrial psychology, and even micro- and macroeconomics. I became aware of many disciplines, and I think I was in a perfect position to elect a specialty later."

His specialty, electronics, holds off-the-job fascination for him. He has a computer at home and is working on developing software building blocks for controlling robots.

who writes the popular monthly column "Strictly Personal," developed the "Job Satisfaction Quiz" that appears on page 102. It is designed to help you analyze the things related to your work and your company that are of major importance to you.

A "blow-your-own-horn" ability is crucial whether you are looking to advance in your own organization or seeking a spot in a more-enticing situation.

Consultant Halperin presents this picture of what companies want to know from candidates they're considering for IE or manufacturing engineering positions: "Critical to employers is implementation and quantified results. In the interviewing process, companies are interested in quantified results, be it in reduced overhead while maintaining productivity, or increased productivity while maintaining overhead, or, best of all, improved productivity while reducing overhead."

A candidate's ideal qualifications "will include emphasis on what the individual has accomplished rather than duties. Key words are: 'created,' 'initiated,' 'developed,' 'implemented.' Results achieved should be quantified wherever possible ('saved the XYZ Co.$xxxxx')."

"The major error made by job seekers is to emphasize responsibilities rather than accomplishments. Companies are more interested in the latter. The good candidate should be able to show a prospective employer how he would be a profit center for that company."

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Verbal skills, Halperin says, are important. "The most common weakness in candidates is lack of personal marketing skills—selling their own accomplishments. This goes hand in hand with a weakness in communication skills."

In structuring their job requirements, companies, too, have weaknesses, Halperin says.

"Typically, the larger the corporation, the tighter the specifications are drawn." Where such tight requirements are indeed needed, he indicates, "is where the company has a specific major problem that the individual must be able to address." The production engineer who has encountered that problem and successfully resolved it will have the inside track; other criteria then become flexible.

What goes wrong in other cases, Halperin says, is in the hiring system. "The VP has a need and sends an authorization to Personnel to find a person. He sends a 'job description' and a list of 'candidate criteria.' The criteria tend to emphasize the ideal as it pertains

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Profile: Charles M. Stata

Age: 37
Title: Manager of High Technology, Advanced Manufacturing Development & Technology Section; Small Systems & Terminals Div., Honeywell Information Systems
Location: Billerica, MA
Education: Boston University—1 year, Engineering
Graceland College—Associate of Arts Degree in Communications. B.A. in Business Administration and Economics
Marital Status: Married, two children

Chuck Stata occupies a newly created position—manager of high technology in the Advanced Manufacturing Development & Technology Section of his organization. It would be logical to assume that the main thrust of his work is to introduce onto the manufacturing floor such state-of-the-art innovations as robotics, automation, lasers, CAM, etc. But that is not, in his view, where the contribution of his work will be greatest. More important, he feels, is the way the job interfaces with product design.

"This new position is a reflection of the realization that there has to be a more cooperative interaction between engineering and manufacturing, getting the manufacturing engineer into the scheme of things—into the loop—earlier," he explains.

"We spent a lot of time looking at robots and all the things that the Japanese are supposedly doing right. And we decided that the one most important thing they do that's different from what we have been doing here is taking a team approach to the design and manufacture of a product. This now is something we're driving toward. We now are actually participating at the initial stages of the design.

"If you were going to highlight one area that will affect engineering and manufacturing most in the rest of this decade it is this: The whole automation trend for increasing productivity will be in

designing products that can be implemented effectively in the manufacturing environment.

"The real value of this approach comes when you can automate your *product* and not just your *process*. There's an important difference."

How well did his college studies prepare him for his newly created function?

"I have a very high mechanical aptitude and a fairly strong mechanical bent so I wanted to be in the manufacturing environment. But the one ability that has helped

to the specific role. It is not intended as finite candidate criteria but more as a guide to the Personnel Department. A sophisticated personnel director reviews it, understands its intent and turns it over to one of the young recruiters. This recruiter, unfortunately, takes it literally and reviews resumes that meet the letter of the ideal candidate profile document rather than the intent.

"If you took a given corporate need and reviewed candidate requirements with the corporate recruiter and the department head (or VP) individually, you will find very substantial differences.

"The bottom line for all companies should be determining the objectives to be achieved by the new employee and finding the individual most skilled in achieving those objectives. All other criteria become secondary in importance."

Career 'Disopportunities.' A few cautionary notes also are sounded by Halperin. The first for IEs is "Don't leave manufacturing unless you really want to."

Currently, a large number of IEs in manufacturing companies are being hired away by non-manufacturing organizations. "By making the move away from a manufacturing environment, one starts to close off future doors," Halperin advises. "The IE will find substantial difficulty in returning to manufacturing environments at a more senior level. After a few years, they will find themselves either locked in to the current environment or required to take a step back to get into manufacturing again," he reports, adding that going into consulting does not constitute that hazard.

A second caution is to tread carefully. "When a company makes an error in an executive hire, it may be painful and embarrassing, but can be corrected (terminating the mistake). For the new employee it can be a darn sight more than painful or embarrassing—it can be disastrous to his life at that point in time."

He emphasizes: "In a mistake, the company always survives, only people get burned."

Explaining the importance to an executive search firm (which is engaged by a company to find and carefully screen candidates) of a good match between an individual and the job, Halperin adds: "The role of a responsible executive search firm is to objectively present an opportunity to an individual rather than sell him on a career change. Equally important is career planning with the candidate, to ascertain the compatibility of his goals with the reasonable growth expectation at the new potential employer. If a long-lasting, secure relationship is to be made, both must be able to meet each other's needs both short- and long-term." *Howard C. Tuttle* □

me more than anything else is my communication skills. Whatever I am trying to do—solve an engineering problem or a management-related problem, in implementing the solution it ultimately comes down to a matter of communicating it," he asserts.

"I had an advantage from high school on that I worked part-time and in the summers. This gave me a fairly good idea of what industry was about and what I wanted to do. My main goal or drive or focus was on costs and cost reduction.

"In the jobs I've had since then, whether I've been working in manufacturing or marketing or whatever, the first question I ask myself is: 'How can I improve the cost picture?' "

This attitude has taken Chuck through a wide assortment of jobs, from the time he first hired into Honeywell in 1969 as a production engineer, then becoming a production planner, and later a cost analyst.

He left Honeywell, moving to the West Coast to become a materials requirements planner at Century Data Systems Div. of Calcomp and at Beckman Instruments he was variously a production control supervisor, cost engineer, production engineer and manufacturing engineer.

He came back East three years ago and rejoined Honeywell as a forecaster. He subsequently was named manager of forecasting and scheduling in the organization's Reseller and OEM Marketing Group; and immediately before his present position was created, he was principal production engineer in the Advanced Mfg. Development & Technology Section.

Gaining Time for Tomorrow's Solutions. The major problem manufacturing engineers have in traditionally structured organizations is the time bind they're typically in, Chuck contends. They are presented with a product design to be manufactured at maximum efficiency and with a tight time schedule for it. "I've found that when a person has responsibility for dealing with today's problems along with responsibility for tomorrow's, he never has the chance to look at tomorrow.

"We've worked to head-off that situation," he explains.

"As a new product comes toward implementation after we've had input at the design phase, we do a hand-off to advanced manufacturing—to the producibility and the testability groups. The advanced manufacturing groups make the pilot runs and the initial low-volume proof runs on the product, and from there it is transitioned to the manufacturing engineering groups for handling in the plant."

Because of Honeywell's high level of technology, Chuck considers his new job to be one that will be constantly changing and its responsibilities becoming progressively larger. It will be deeply involved, he notes, "with stretching the total organization's capabilities."

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It is the purpose of **PRODUCTION** to recognize and to fulfill the special needs of the managers and engineers who are responsible for improving manufacturing efficiency, costs and quality in production metalworking plants, and selected supplier industries.

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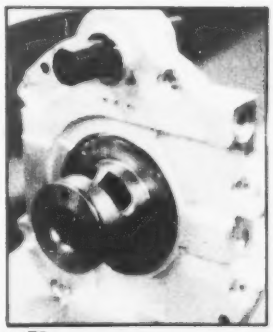

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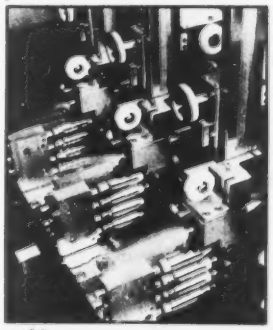

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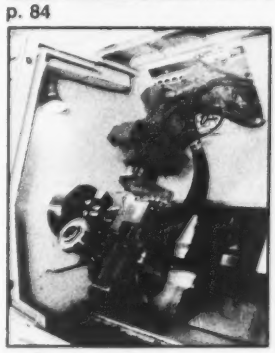

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Cover: The T³ robot reaching in to load/unload this turning center also serves a second machine and the associated gaging station.
Next Month: Implementing Manufacturing Innovations—a PRODUCTION Round Table

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(continued)

the operating income of businesses. Because tax liabilities are based on inflated measures of profit and income, the proportion of correctly measured income paid in taxes rises with the rate of inflation. The primary distortions in business profits most alluded to arise through the overstatement of inventory holding gains and the understatement of the costs of capital."

Major influences in the overstatement of taxable profits include: Use of first-in, first-out (FIFO) inventory accounting which bases material costs on old, under-inflated values, thereby widening the gap between reported costs and the firm's current product prices; and use of a capital consumption, or depreciation allowance based on the original purchase price and failing to allow for inflation's effect on replacement costs over a period of time.

As the table on the preceding page indicates, by converting to LIFO (last-in, first-out) inventory accounting procedures, and by substituting allowed accelerated tax depreciation methods rather than straight-line calculations, taxable profits are reduced substantially, and they more accurately reflect the real condition of the business.

Bigger Defense Business

As President Reagan's defense spending programs go into place, there will be sizable boosts in contract awards. The Federal Reserve Bank of Philadelphia notes that defense outlays, which dropped to less than a quarter of the total Federal budget outlays in the late 1970s, is now estimated to rise to one-third of the total by 1984. This means that Defense will be increasing its share of GNP by about two-tenths of a percent a year.

A release from the Defense Department says the DOD budget calls for increasing civilian direct hires by 55,000 over 1980 levels by the end of 1982. Defense-related industries, supplying both hardware and services, are expected to need some 445,000 additional workers by the end of fiscal 1983, nearly half-a-million new jobs.

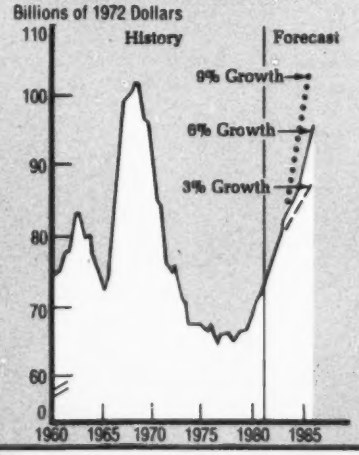
Three factors will have major influence on who gets in on the bulging business. First will be the industry involved. A report by Robert Gough, Data Resources Inc., a Massachusetts econometric forecasting firm, lists the ten industries (shown below) most likely to get the lion's share of the business.

A second factor is unavoidable; it's politics. The bank notes that statutes and regulations can require the government to pay some attention to local economic conditions in allocating contracts.

Third, DOD is increasing its emphasis on the cost-effectiveness of contractors as automated management information systems provide more and better data in better formats to people at the policy level. □

DEFENSE PURCHASES TO TAKE SHARP UPWARD TURN

Defense Purchases of Goods and Services Seasonally Adjusted Annual Rate



THESE INDUSTRIES MAY GROW

The Ten Industries Most Impacted by an Increase in Military Spending (Percent change in industrial production from six percent to nine percent growth in real military spending)

	1983	1984	1985	1986
New Military Facilities	1.9	5.0	8.0	13.4
Ammunition, Except Small Arms	1.8	5.0	7.7	12.8
Other Ordnance & Accessories	1.6	4.1	6.4	10.6
Complete Guided Missiles	1.3	3.7	6.0	10.2
Tanks & Tank Accessories	1.4	3.6	5.8	9.6
Small Arms Ammunition	1.2	3.2	5.1	8.5
New Industrial Buildings	0.4	2.0	4.6	8.1
Aircraft Engines & Engine Parts	1.2	3.2	5.0	8.0
Shipbuilding & Repairing	1.2	3.1	4.8	7.9
Aircraft Parts & Equipment	1.1	2.8	4.3	6.8

Source:
Robert A. Gough, Jr., "The Defense Budget: Issues and Outlook," materials presented at the Data Resources Quarterly Outlook Conference, New York, April 29, 1981.